One View of the NSLS from the Perspective of SRI 2000

Erik Johnson

Head, NSLS Experimental Systems Group

'The NSLS continues to be a vibrant international center for synchrotron radiation research. Continuous machine improvements coupled with a broad spectrum of technique and instrument development at the NSLS contribute to this vitality. With 70 beamlines and more than 5000 hours of scheduled operation on each of its two storage rings, last year over 2400 users from around the world came to conduct their research at the NSLS. The community is quite dynamic with nearly 800 new users each year while the life sciences has become a leading constituency comprising nearly 1/3 of NSLS users. The poster on the following page provides a small selection of some of the activities and trends at the facility'. *This was the way the NSLS introduced itself in the facility poster prepared for the SRI 2000 meeting held in Berlin this summer. But more about that later…*

The 7th International Conference on Synchrotron Radiation Instrumentation was hosted by BESSY and the TU Berlin with Wofgang Gudat and Peter Zimmermann as co-chairmen. It ran from August 21st to the 25th and was attended by over 700 people from around the world. A broad range of topics were presented by 109 speakers in 31 sessions, and in the 440 posters discussed during the two poster sessions. In addition, there were 60 vendor exhibits and 21 facility posters that ran throughout the week. The technical meetings were held in the historic Hauptgebäde (Main Building) of the TU Berlin and on one afternoon the new 'third-generation' BESSY II facility was showcased in a tour and reception in its Berlin-Adlershof (East Berlin) location. Housed in an elegant new building the BESSYII machine is more than equal to the architecture, and is already supporting an active scientific program. Between their new facility and their highly successful conference, our hosts have much of which they can be justifiably proud and have set a very high standard for organizers of the 2003 SRI meeting in San Francisco.

With a large scientific community, now over 2500 active users, providing a representative view of the NSLS presented something of a challenge. Within the context of the meeting, it seemed most appropriate to focus on the science driven instrumentation developments supported by the department. As a guide for what to include we referred back to our mission statement for our users:

- Develop new capabilities to maintain the facility at state-of-the-art
- Encourage new communities from all fields to use the NSLS
- Operate key facilities for the benefit of the general user community

The result (reformatted for the newsletter) appears on the following pages. Two major facility improvements since the last SRI were an enhancement of the X-ray ring brightness by a factor of 5, and the completion of the beamline upgrade program on the VUV-ring.

The breadth of the NSLS research is also one of its greatest strengths. An example combining novel spatial probes for new insights was presented where complementary IR and x-ray microprobe studies were conducted on bone samples. Another illustration of novel science was a section of the poster devoted to the study of interface magnetism using soft x-ray magnetic scattering.

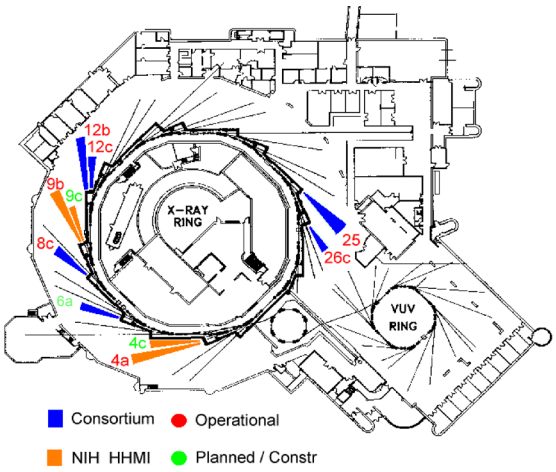
There have also been specific instrument enhancements such as the installation of a Circular Polarizer on the U5U undulator, and the ongoing development programs in detectors and diffraction enhanced imaging. The macromolecular crystallography consortium was also presented as an example of a growing community for the NSLS and looking toward the future, the Deep Ultra-Violet Free Electron Laser research program was outlined. Taken as a whole, the focus provided by the meeting underscores the fact that the NSLS is indeed a vibrant part of the synchrotron radiation based research community, and can remain so for many years to come.

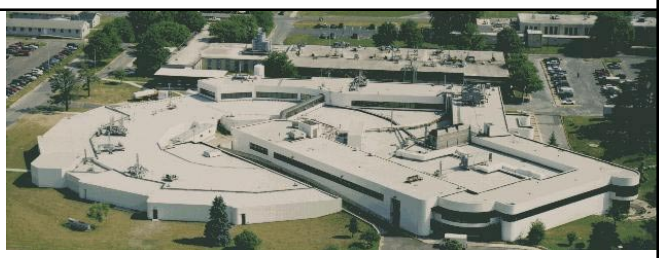
Breaking News!!

2551 users from 417 institutions visited the NSLS to perform 1132 experiments in FY2000

National Synchrotron Light Source

Macromolecular Crystallography Facilities





Our mission for our users

> Develop new capabilities to maintain the facility at state-of-the-art
> Encourage new communities from all fields to use the NSLS
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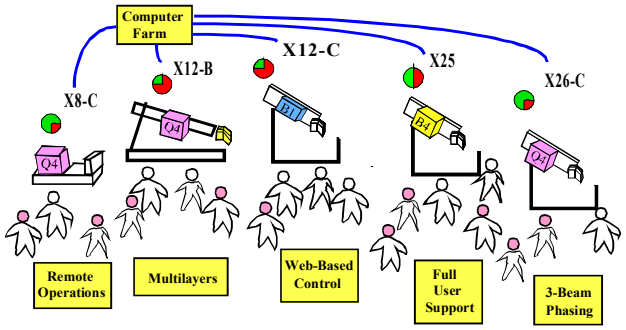
Due to the number of graphics in this article, figures have been spanned over several pages to reduce browser loading time.

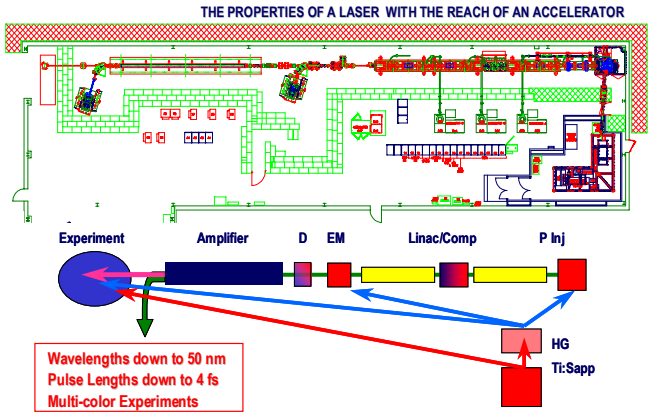
National Synchrotron Light Source

BNL Biology/NSLS Consortium and NIH Research Resource

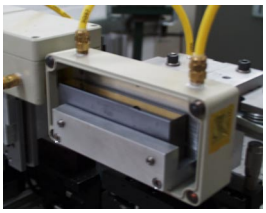
> Beamlines are organized to serve users and share apparatus and personnel
> Funding comes roughly equally from DOE/OBER and NIH/RR

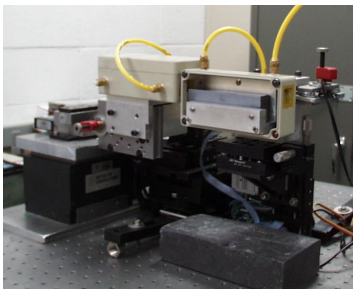


Deep Ultra-Violet Free Electron Laser (DUV-FEL) Sub-harmonically Seeded High Gain Free Electron Laser



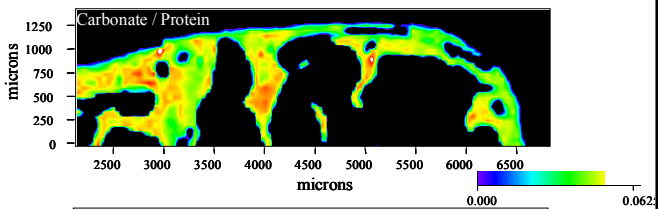
Combining Novel spatial probes for new insights: IR and X-ray microprobe studies of bone

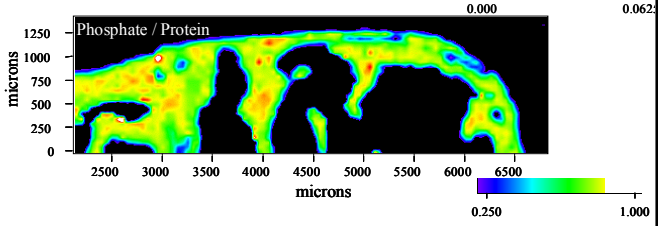




* Portable, ellipsoid mirror system for micro-focusing of x-rays
* Focus x-rays to 10x10 µm

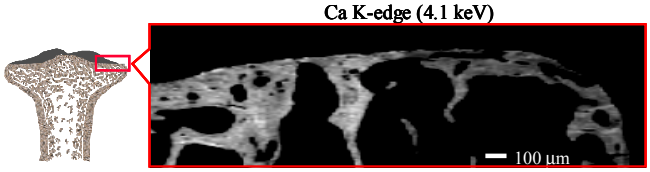
Phosphate, Carbonate, and Protein in Bone Disease





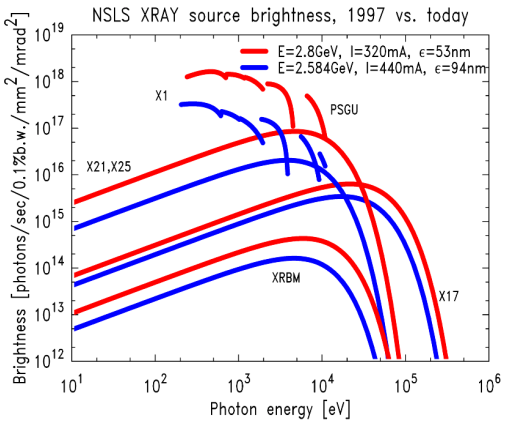
Hydroxyapatite: $Ca_{10}(PO_4)_6(OH)_2$

* Ca content: x-ray absorption micro-spectroscopy
* PO_4^{3-}, CO_3^{2-}, protein composition: IR micro-spectroscopy

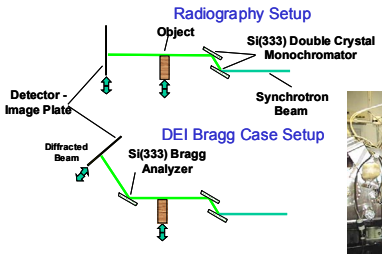


SCAN PARAMETERS:
• 5x15 µm beam size
• 10 sec/pt., collect Ca fluorescence / Io

NSLS X-ray Brightness 1997 to 2000



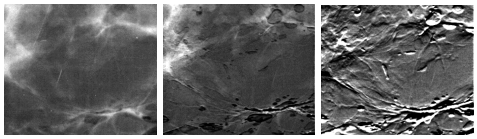
Diffraction Enhanced Imaging at NSLS-X15A



Sources of Contrast:
DEI --- Normal Absorption
Refraction
Extinction -or- Scatter Rejection
Radiography…Normal Absorption

Experimental Setup at NSLS X15A

Cancer in Breast Tissue

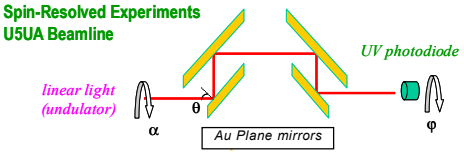


Conventional | DEI - Absorption | DEI - Refraction

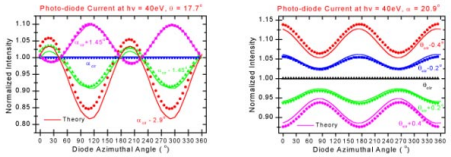
Events

Circular Polarizer for U5U

Spin-Resolved Experiments
U5UA Beamline

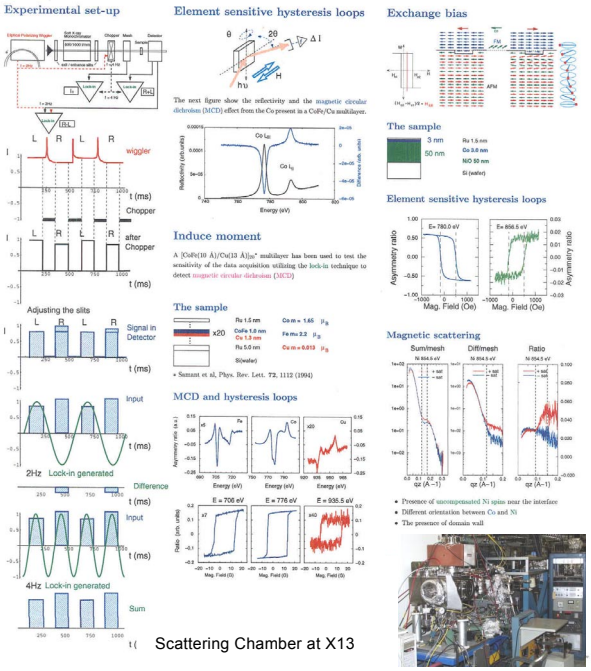


In the UV energy range (10 – 100 eV), the intense linearly polarized light from an undulator can be efficiently converted into circular polarized light using a quadrupole reflector. This tool extends the capability of the spin-resolved photoemission program at the U5UA beamline at NSLS.



Examples of photodiode current produced by 40 eV light as a function of the (diode)φ angle, for various conditions of incident light (α, β). Approaching the incident conditions (±20.9°,17.7°), the diode oscillation vanishes: the light is 100% circularly polarized.

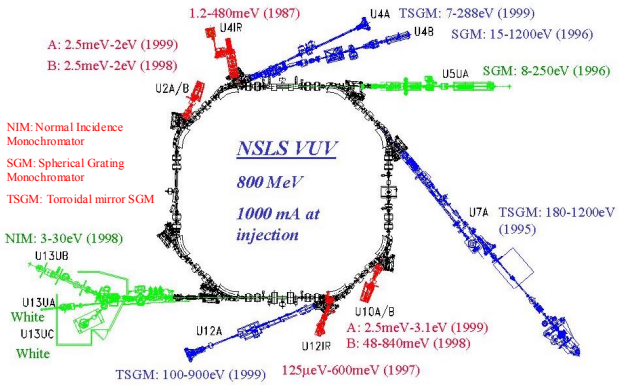
Studying Interface Magnetism using Soft X-ray Resonant Magnetic Scattering



Scattering Chamber at X13

Events

New and recently upgraded VUV beamlines



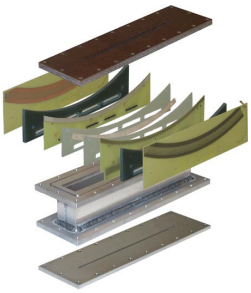
Detector Development at NSLS

Multi-element silicon diode arrays Optimized for specific experiments
Typical resolution 350eV @ 6keV

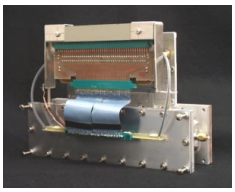
Special-function silicon diode arrays Optimized for specific experiments e.g a circular pie-segment array with a central hole for fluorescence EXAFS from a diamond anvil pressure cell

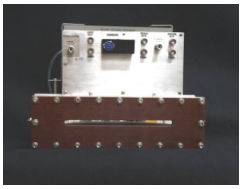
Curved, high-through put proportional counter
Provides parallax-free operation for powder diffraction
Throughout up to 10MHz

Cadmium Zinc Telluride detector arrays
Capabilites similar to the silicon work, but for energies above 15keV



45° 1D Curved Detector with Anode Blade





NSLS Staff and Users

Eileen Pinkston, Kathy Loverro, and Toni Hoffman

Steve Kramer, Nicholas Gmür, and Bob Casey

Mary Anne Corwin, Susan Hart, Conrad Foerster, and Mike Kelly

NSLS 2000 Annual Service Awards Barbecue and Farewell to Michael Hart, Chairman of the NSLS

Michael Hart

Michael Hart and Frank Terrano

Wayne Rasmussen and Rich Biscardi

K. Rajashankar, Lonny Berman, and Susan Hart

Tom McDonald and Randy Church

Judy Thompson

Eric Blum and Herb Langenbach

Nebojsa Marinkovic, Bill Cahill, K. “Raj” Rajashankar, and Denis McWhan